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**USING COMPLEXITY THEORY TO CONSTRUCT A DIGITAL
LEARNING ENVIRONMENT FACILITATING EXPERIENTIAL LIFE
EDUCATION PROGRAMS ON ELEMENTARY SCHOOL TEACHERS
AND STUDENTS**

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ABSTRACT: E-learning has become a global trend, however, the entire globe is facing the problems of social disruption and disorder, overwhelmed with sensual desire, and filled with distorted sense of ethics and morality, it has a strong need to guide the younger generation to understand the meaning and purpose of life through life education. Therefore, there is an urgent need to understand how to develop, implement, and promote experiential life education programs with technology support environment. Complexity theory has been pervasively applied in education and management to adapt multiple environmental changes and multidisciplinary collaboration in recently research. Evolving from chaos theory, complexity theory not only keeps the unpredictability and nonlinearity in education models but also develops mutual-adaptation, co-evolution, dynamic interaction and self-organization. Therefore, it is appropriate to use this theory to construct educational models in complicate educational areas. The study used complexity theory as the theoretical basis and utilized a series of high-definition digital TV programs as teaching materials to develop life experiential education courses model and understand its effectiveness for elementary school teachers and students. The study was conducted by observing volunteer classes to understand the design of digital learning. One unit of a national popular TV program, "Let's Play Stories", was be utilized as the teaching materials. Attitudes and behaviors of teachers and students during participating, suggestions from teachers, feelings and learning of students, and interactions were investigated. Purposive sampling was used to collect five schools in northern and central Taiwan. Qualitative research methodology was the major research approach to construct the teaching model. The results of the study showed that four themes, mutual-adaptation, co-evolution, dynamic interaction and self-organization, could be found in qualitative information from teachers, students and volunteers. The study help us to understand how to establish digital learning model and effectiveness of using complexity theory to construct a digital learning environment facilitating experiential life education programs on elementary school teachers and students in real teaching sites.

Key words: Complexity, experiential education, life education

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INTRODUCTION

Experiential education (EE) is the process of learning through experience to change learning behavior, critical thinking and problem-solving ability (Patrick, 2011). By means of using EE in teaching method, teachers has great capacity to help student achieve: (1) a deeper understanding of subject matter, (2) an application for dealing with complex situations, and (3) the ability in lifelong learning (Eyler, 2009). In the developed process of school-age children, experiential life education (ELE) played an important role to their physical and mental states. Shortill (2011) pointed out that experiential life education might develop a joyful atmosphere that can stimulate the energy, spirt, and emotion. ELE has become a crucial part of educational setting in schools nowadays. However, it is challenge to promote ELE in elementary schools because there are only a few teachers who are able to provide ELE courses correctly. Therefore, with the advancement of technology, it is a valuable approach to combine ELE with technology and to re-examine its outcomes.

Over the past 10 years, technology and media have been developed significantly. Among the massive technology-enhanced learning approaches, e-learning has been used to motivate students' self-learning behavior. Researchers pointed out that e-learning not only can significantly improve individual's cognition but can stimulate their thinking behaviors and problem-solving abilities (Brown, Collins, & Duguid, 1989). E-learning which provides individualized teaching materials for each student was able to decrease lower dropout rates (Njenga & Fourie, 2010). Recently, scholars utilized e-learning into a verity of teaching subjects. For instance, Huang, Nien, and Yeh (2015) mentioned that Automated Composition for Music Software (ACMS) have a better learning effectiveness to students who are unfamiliar with music theories than the control groups in the elementary schools. Other researchers developed software to support classrooms in the elementary English as second language (ELS) class and found that e-learning significantly enhance students' learning effectiveness (Kuo, Yu, & Hsiao, 2015).

The use of technology in the classroom has increasingly noticed in recent year. However, there is no consensus on how to use the digital devices to guide the younger generation. Little is known about the conceptual framework understanding the meaning and purpose of life and social interaction through life educations. In order to understand these multiple phenomena, it is necessary to present a conceptual theory for liking students' behaviors and digital experiential life education (DELE). Complexity theory has been applied pervasively in education and management to adapt multiple environmental changes and multidisciplinary collaboration in recently research (Paley, 2007). Evolving from chaos theory, complexity theory not only keeps the unpredictability and nonlinearity in education models but also develops mutual-adaptation, co-evolution, dynamic interaction and self-organization (Stacy, 1996). That approach can lead eventually to maintain the harmonious situations. Therefore, it is appropriate to use this theory to construct theoretical educational models in such a complicate educational environment. The purpose of this study is to understand how to establish digital learning model and effectiveness of using complexity theory to construct a digital learning environment facilitating experiential life education programs on elementary school teachers and students in real teaching sites.

METHODS

Participants

The study was conducted in two elementary schools in northern and central Taiwan. In order to respect the personal rights in rights in making decision of their own, non-random purposive sampling were utilized in this study. All schoolchild participated in the study were pre-approval by their parents, instructors and school authorities. A total of 65 schoolchild participated in the 4-week DLE program.

Intervention

The study used complexity theory as the theoretical basis and utilized a series of high-definition digital TV programs as teaching materials to develop life experiential education courses model and understand its effectiveness for elementary school teachers and students. Units of a national popular TV children program, "Let's Play Stories", are used as the teaching materials in the study. The accumulated viewers of this TV program reached 35,557,918 times on 2015, January 1. In the beginning of the intervention, observing volunteer read picture books (Figure 1) to the participants. In order to introspect the meanings of the picture books, the participants were asked some question about the stories. Then, the participants watched "Let's Play Stories" TV program (Figure 2, Figure 3) and did the related life experience activities (Figure 4). Every unit of TV program, the picture book and the activity were closely matched to every notion of DELE. Table 1 presents the intervention program.

Table 1. DELE Program Plans

Time	North school in Taiwan DELE program	Central school in Taiwan DELE program
Week1 picture book activity	I've been spread myself too thin Divvying	That grandma, this grandma Endorsed game
Week2 picture book activity	That grandma, this grandma Endorsed game	I've been spread myself too thin Divvying
Week3 picture book activity	Ms. grey heron and Mr. crane Colliding brick	A-Ci is unwilling to change his socks Pyramidal cup
Week4 picture book activity	A-Ci is unwilling to change his socks Pyramidal cup	Ms. grey heron and Mr. crane Colliding brick



Figure 1. Volunteer described the “picture book”



Figure 2. “Let’s Play Stories” TV program



Figure 3. Students were watching TV program



Figure 4. Students did some activities

Measurement

We investigated attitudes and behaviors of teachers and students during participating. It included the suggestions from teachers of feelings, learning of students, and thoughts of volunteers. Qualitative research methodology was the major research approach to gain an in-depth understanding of teachers, students and volunteers and to construct the teaching model. Attitudes and behaviors of teachers and students during participating, suggestions from teachers, feelings and learning of students, and interactions were investigated. A semi-structured interview method was chosen to collect thoughts of schoolchild and their teachers at the end of the 4-week DELE program. An interview guide, containing open-ended questions, was developed from literature reviews and approved by the research team. In addition, three volunteers also described their observation and recalled their reports after each intervention. Core questions from the interview guide are shown in Table 2.

Data analysis

The study used thematic content analysis to analyze the content of the transcripts. During the analysis, the study read through interview transcripts of the students, teachers and volunteers to gain an overall impression of the content, and to conceptualize tentative properties. The short codes, phrases and sentences of the transcripts were managed and assigned into themes based on complexity theory. During coding, the tentative property were revised and refined to more precisely reflect the data into each theme (Dynamic interaction, Co-evolution, Mutual-adaptation, and Self-organization) of complexity theory.

Table 2. Guiding Questions

Groups	Sample of Interview Questions
Students (N = 65)	<ol style="list-style-type: none"> 1. Please tell me how you feel about DELE program. 2. How satisfied are you participating DELE program? 3. Are there any other feedback or thoughts you what to share? 4. Describe how participating DELE program changed your peer relationship. 5. Describe how participating DELE program changed your life.
Teachers* (N = 3)	<ol style="list-style-type: none"> 1. Please describe which part of DELE program makes you impressed? 2. Please describe your thoughts about the necessity of life experience. 3. How satisfied are you participating DELE program? 4. Are there any other feedback or thoughts you what to share? 5. Do you discover any behavior changed from your student? 6. Do you think that DELE program makes your class any changed? 7. Based on your experience, what is different between life education and normal education? 10. What can we change to make DLE program better? 12. Do you think that DELE program is a good fit for students in zero hour physical education? 13. Do you think that DELE program is a good fit for students in elementary education? 14. Would you recommend the DLE program to the schoolchild in elementary?
Volunteers** (N = 3)	<ol style="list-style-type: none"> 1. Please describe students' behavior when they watched "Let's Play Stories" program at the first time. 2. Please describe the peer interactive when you lead the life education. 3. Please describe the behavior changes of students or classmates after they took apart in DELE program. 4. Do the students dislike or compete with each other at first; however, they changed/adjusted their behavior after participating DELE program. If it happened, please describe details about this situation. 5. Do the students' interaction form a new rule after participating DELE program?

* Three teachers are Wu (W1), Wu (W2) and Chen (C)

** Three investigators are Tsai (T), Fu (F), and Wu (W)

RESULTS AND FINDINGS

Four major themes, Dynamic interaction, Co-evolution, Mutual-adaptation and Self-organization, were generated to illustrate the digital learning model in the study.

Dynamic interaction

Compared with the static and one-way rules, complexity theory appears to dynamics and non-linear interaction. Dynamic system is not under domination of single and authoritative rules. In contrast, any interactions can be exchanged their relationship, interrelated parts and some behavior contributing to complexity interactions (Guastello, 1997). Like our observation from (V_T):

"Most students were focus on the "Let's Play Stories" TV program. A portion of students made some noises (hubbub...) when they saw something that are familiar with their past experience... they always whispered with their peers and said "Oh! I do know how to play this!" (V_T)

The results showed that DELE developed good outcomes and feedbacks from students. DELE provided good opportunities for students to have dynamic interactions in play that helped students to understand life education goals because play is a intrinsically, motivated and preserving behavior throughout life. Bergen (2009) noted that people in young age shows interrelated and interdependent play as a result of children often move back and forth between all levels of play and different difficulty of play. He also mentioned that play has both stable and dynamic interactions so that the patterns of play is always changed by the environment. Those students identified that DELE offered great opportunities for them to learn a variety of life educational goals by experiencing activities and dynamic interactions with peers.

Co-evolution

Stacy (1996) considered complexity theory as the unpredictable forms, which may have the contribution of the feedback loop in order to the assist in environmental interaction with nonlinear pattern. Co-evolution in the process of complexity theory played a critical role in helping organizations and individuals to improve the level

of renewal necessary for successful evolution (Porter, 2006). When using this concept in the teaching sites, we can see this change from mechanism more clearly. For example, one interviewee remarked that:

“Although these kids have got together for a while, they were too shy to show themselves when doing the activities in the very beginning..., like introducing he/herself on the stage, they were quite bashful. However, some kids vigorously got off the stage and cheered their groups up enthusiastically..., it was very interesting for comparing on and off the stage!” (V_W)

“In very beginning of the activity, students who stood in their groups for taking apart in life experience were always a small portion of them... students who were willing to express themselves liked to participate the activity, vice versa... However, some active students knew that they had limit opportunities to play a part in activity after the first activity. Then, they began to cheer up when they took the lead.” (V_W)

Through the observation, we could discover that students involved interspecific changes in the process of co-evolution after participating DELE programs. These students experienced the transmission in the crossing boundary of interrelationship result from the collaboration of social networking. Finch, Peacock, Lazdowski and Hwang (2015) presented that team-based experiential activities could emulate interdependency within groups, which triggered students' emotional responses from negative to positive attitudes. Moreover, EE not only can motivate the passion of students to deal with complex new situation but also make students monitor their own understanding to grapple with alternative perspectives (Eyler, 2009). On the other hand, we can find out that social behaviors and peer relationships evolution from this stage. As one student commented:

“I am able to get along with other classmates gradually.” (S_1)

“One of student (S_2) was timid in groups at the first activity; however, she changed her attitude and became open-minded to other people in the end of the activity.” (V_T)

“Originally, I was a very shy person, but I felt much better and was not embarrassed anymore after taking apart in the activity.” (S_2)

There is a general agreement from our participators that the increased their acceptance into their peer groups after DELE programs. This transformation is similar to the concept of Complexity theory. Bloom (2009) mentioned that students learning appears as groups working together, groups socializing and teachers interact with student when schooling were consistent with learning as a complex system. The result clearly showed a social process of group members who were willing to adopt each other. Thus, with the mentioned above, DELE program in the process of co-evolution has the potential to incorporate the loners to join the group and develop social adjustments to cope with teamwork.

Mutual-adaptation

Mutual-adaptation identifies that the relationship of competitive partner and cooperative rivalry are coexist in this process. This transformation occurs when group members tried to figure out the possibilities of real-world problems and current issues (Chiang & Chen, 2011). In coping with multidisciplinary cooperation in the groups, students developed by modifying their own nature to suitable for others. The following comment can help enlighten us on this:

“The students had lower acceptance and tolerant toward the outcomes of gaming performance. If they disappointed to the outcomes, they made fun of other group members...even more reluctant to join the activity anymore; however, they started to exchange opinions and accepted other critique, as well as they found their win-win solutions in order to gain their victories and applauses.” (V_W)

“Particularly, one student, who considered herself as stranger in the group at first...but, she tried to collaborate with her group members and others tried let her fit in this groups. She was pleased to this process.” (V_T)

“Most students talked about that they could become a good friend with unfamiliar classmates after the DLEL programs.” (V_F)

“They didn't want me to be their members... unexpectedly! They helped me when we played the game!” (S_3)

“Well...I think a change might be their interaction with each other!” (T_W)

In the reports and interviews, most students indicated that DELE programs bettered their peer relationship. In light of mutual-adaption, these responses were examples of how students provided their pre-conditions and expressed their social behavior changes in order to reposition in the group. During this process, the individuals usually includes four quadrants: interaction, appropriation, repositioning and publicization (Thi, 2008). Our findings echoed with the studies discussed above. When students came into a new environment, they could transform their won disciplinary to the new group. Then, appropriated and repositioned experiences to assimilate with the teamwork are possible ways to happen. In the DELE programs, there is no clear distinction between the role of each group member. The students tried to establish the consensus to collaborate with each other and found possible solutions in the process of mutual-adaption. There are viable ways to motivate students to collaborate via utilizing game-based learning (Chiang, Shih, Liu & Lee, 2011).

Self-organization

Self-organization recommends that the individuals can be regularly reconstructed and evolved in order to form the new pattern, rule and law. The notion of self-organization usually evolves in the state of equilibrium and based on three ingredients: (1) strong dynamical non-linearity, (2) balance of exploitation and exploration, (3) multiple interactions (Bonabeau, Dorigo, & Theraulaz, 1999). The principles of self-organization could operate among at schools, teaching and learning. Students in this study perceived the action as inconsistent and dissonance within the group before changing attitudes. Then, they started to justify their behaviors in order to maintain the balance of the group. For example, the interviewee remarked that:

“Instead of controlling the group of communication, those students started to care for other people’s feelings and thoughts. We could see this clearly from some students who could neglect their disagreements and took the matter on its merits rather than sticking to one’s position.” (V_W)

“Undergoing this DELE program, the students had increased the chances to collaborate with unfamiliar classmates. Therefore, they understood themselves and each other better.” (V_F)

Our results show that those students began to cooperate with each other and started to “self-organize” to accomplish the mission of DELE programs after this 4-weeks intervention. The results are similar to Caulfield and Woods (2013) studies, which implied that ELE might contribute the socially responsible behavior changes. DELE programs may influence students to seek a better understanding to rebuild their friendship by helping them to make sense of complex interactions.

CONCLUSION

Complexity theory is a viable theory for developing a complex DELE model to facilitate successful learning environments on elementary schools. This model has indicated evolved four themes (Dynamic interaction, Co-evolution, Mutual-adaptation and Self-organization) in the direction of developing social adaptation of peer relationship during participating DELE programs. The results of the study also give us comprehensions regarding how students’ feelings, interactions and peer collaborations can possibly lead to modify their social behaviors to gain the better outcomes of each DELE mission.

RECOMMENDATIONS

An area of future research that should be considered is long-term interventions of DLEL programs because it could gain more subtle observations from students who may exchange their social behaviors. Besides, the interview questions are subjective to constant revision and changes in order to improve in order to obtain more reliable and objective data. Further research might usefully extend complexity theory to examine impacts of DELE programs to construct a digital learning environment on elementary schools in real teaching sites.

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